Columbia University
in the City of New York

LAMONT GEOLOGICAL OBSERVATORY
PALISADES, NEW YORK

Technical Report No. 5

CU-14-54-N6 onr 27124 Geol.

Portable Direct Writing Drum Recorder

November 1954

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(Columbia University)

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PORTABLE DIRECT WRITING DRUM RECORDER

by

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PORTABLE DIRECT WRITING DRUM RECORDER

ABSTRACT

A Sanborn hot wire writing pen has been modified to write on a seismograph drum with an extremely fine trace. The resultant recorder is a convenient portable rugged instrument. Construction techniques and a parts list are included.

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In our geophysical research program there has continually been a need for a portable unit suitable to record low frequency geophysical phenomena. These phenomena are in the frequency range from DC to 70 cps and include ocean waves, earthquake phases or seismic signals in the ground, and ambient noise studies. Some are steady state phenomena, others are transients that occur at random infrequent intervals. The necessary recording in one case may be made in a few hours, in another it may require a few years. A visible recorder, with its presentation of the incoming signal as well as the past record, is usually desirable. A drum recorder, that presents the data on a single sheet of paper rather than a long strip of paper, is a great convenience in studying or reducing the data.

To fill our need for such a recorder we have modified the Sanborn "hot wire" writing arm to allow use of the Sanborn direct writing galvanometer on a rotating drum. As used by Sanborn, their writing galvanometer is designed to write on a strip of paper as it is drawn from a 200-foot roll. This hot wire type writing galvanometer is more satisfactory than the pen and ink type writing galvanometer for a rugged portable recorder. A typical such drum recorder is shown in Figures 1 and 2 mounted in a 19-inch relay rack. We originally modified the Sanborn writing arm to write on a drum by simply crimping the hot wire or resistance element. Our present technique is to silver solder a sapphire phonograph stylus, as shown in Figures 3 and 4, to the hot wire element. The life of these modified writing arms varies from 1 to 4000 hours depending upon the excellence of the sapphire silver soldering, specifically whether or not the temper in the resistance element is lost. This provides a trace .003 inches wide on the regular Sanborn heat-sensitive paper, known as Permapaper. To operate the heated element at lower temperature, insuring longer life, the Permapaper is insulated from the metal drum by a single layer of blotting paper, scotch taped to the drum. A small portion of a typical record is shown in Figure 5.

Typical recorders used by us may be described briefly as follows:

(a) A large twenty-four hour recorder, using a 12-inch diameter drum, 12 inches long, rotating at 8 RPH. This has a paper speed of

120 mm/minute. The line spacing is 1/20 inch. The 24-hour record is a 12" x 38" sheet, a portion of which is shown in Figure 5. The actual extended length of the trace on this record is about 600 feet. The drum used is a standard seismograph recording drum such as is manufactured by the Sprengnether Instrument Company, St. Louis 10, Missouri. As in the usual seismograph recorder the drum translates horizontally. In this application there is therefore no need to translate the writing galvanometer.

(b) A small recorder utilizing 6 inch diameter drum 10 inches long such as is shown in Figures 1 and 2. The parts list for this recorder is given on Pages 4 and 5. Variable paper speeds and line spacings are provided by the gear box shown. Paper speeds as high as 1 inch/second have been used on this unit. The writing galvanometer rests partially on, and is translated by, a lead screw. A microswitch is provided to cut drive motor power and stylus heating current at the end of the record.

We have found the Sanborn amplifiers to be excellent units for driving their writing galvanometers. Their DC amplifier #67-300 at about $250.00 has a max sensitivity of 1 cm deflection for 50 millivolts input. A strain gage amplifier is available. These amplifiers are designed to overload before driving the writing arm into the stops. Figure 6 is a DC amplifier used by us that will drive the writing arm linearly

from stop to stop. This is a distance of 5 centimeters. It is suitable only for applications where signals large enough to drive the writing arm against the stops do not exist. In our application this is the rectified output of a logger circuit.

PARTS LIST - FIGURES 1 and 2

Writing galvanometer: Sanborn Company, Cambridge, Massachusetts, #51-500, cost about $85.00.

Writing arm: (Fine line stylus) Sanborn Company, #572-1322, cost about $7.50. The wide line stylus is not suitable.

Permapaper: (Heat sensitive paper) Sanborn Company, #64-1507P1 unprinted rolls 10 inches wide, 200 feet long, cost about $11.00 per roll, available other size rolls and as sheets.

Drive motor: Barber Coleman Company, Rockford, Illinois, #PYAZ 929 FZ KYAJ 622-1, 1 RPM, 115 volt, 60 cps synchronous motor, cost about $18.00.

Drum: Gorrell and Gorrell, Haworth, New Jersey, all aluminum, 5/8" bore, 6.25" diameter, 12" long, cost about $12.50.

Lead screw: Purchased as replacement lead screw for: Logan Engineering Company, Model 200 bench lathe, 8 threads per inch, cost about $9.00. Sears and Roebuck Craftsman lathe 99HM2048, 16 threads per inch, cost about $5.00.

Both of these are long enough to provide lead screws for 2 drums such as those shown in Figure 1.

Writing arm heating transformer: United Transformer Company, New York City. CG 34 primary 105 115 220 230, 50/60 cps, secondary 2.5V center tapped at 10 amps. This transformer will heat four writing arms. Cost about $7.00.

Writing arm heating control potentiometer: 1/2 ohm, 10 watts.

Writing arm sapphire tip: Philco #45-1650 replacement sapphire phonograph stylus. A stylus with the jewel set in a material that may be brazed is need, i.e. a brass, not an aluminum mounting, cost about $1.50.

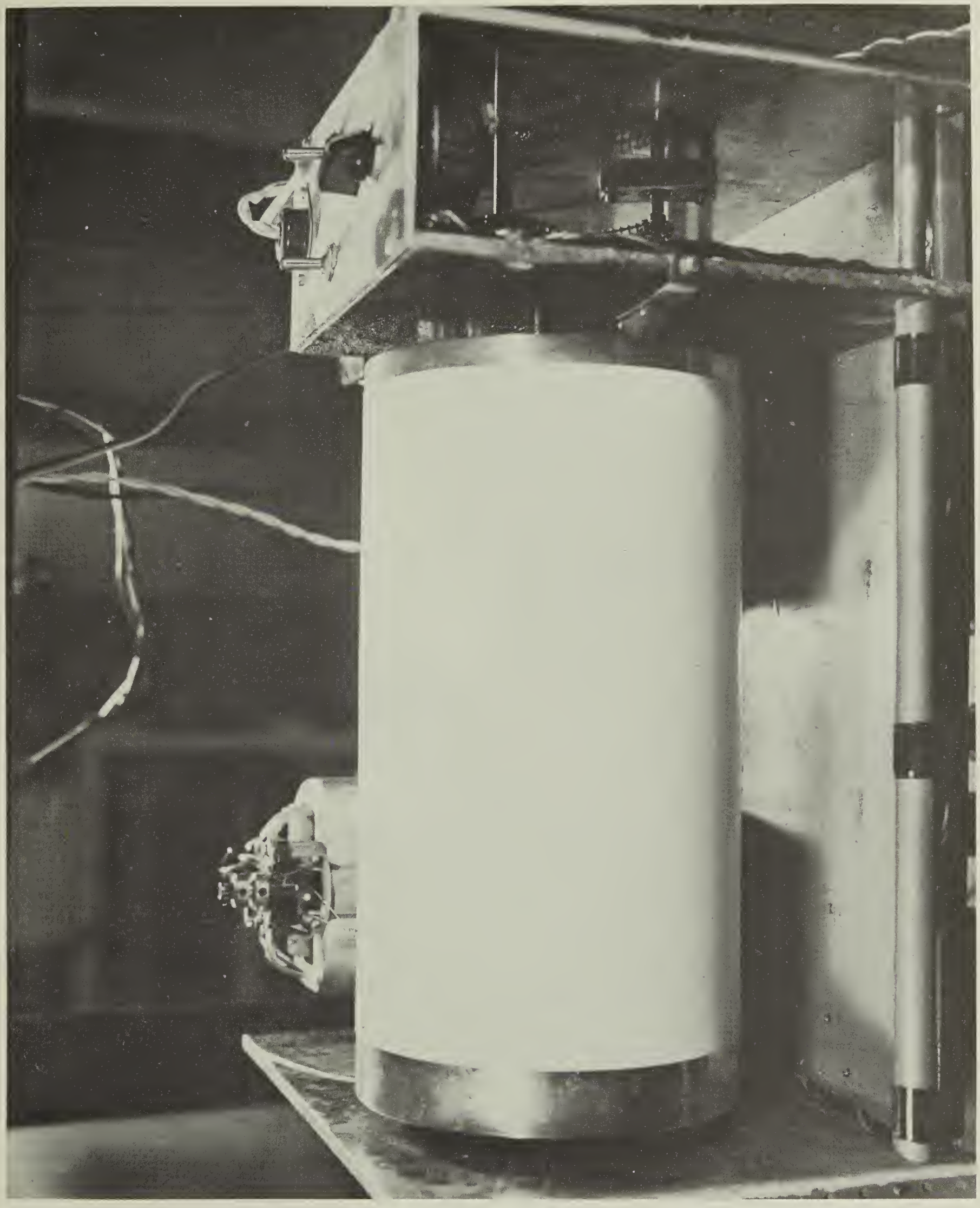
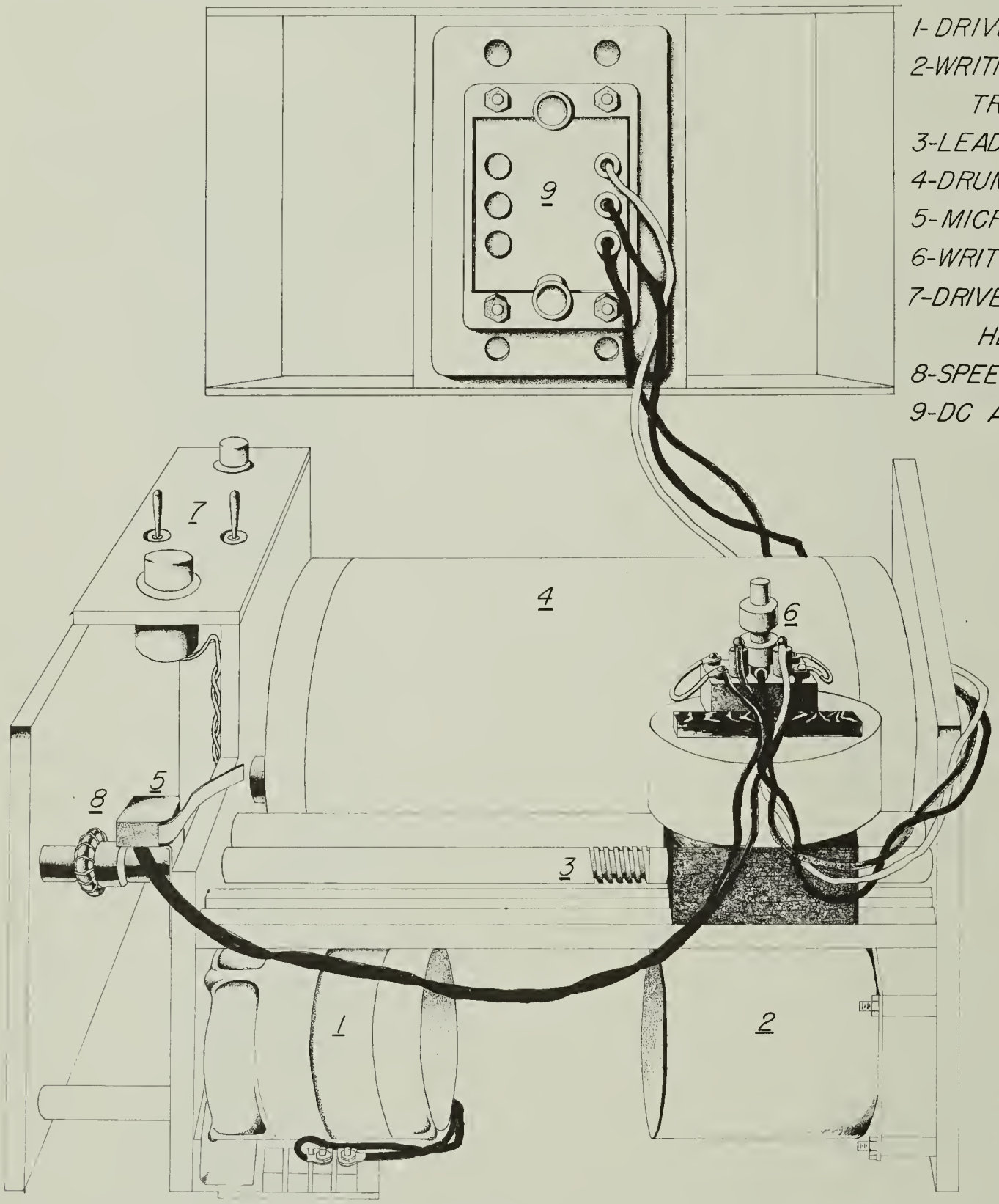


Figure 1. Front view small recorder.



1- DRIVE MOTOR
2-WRITING ARM HEATING
TRANSFORMER
3-LEAD SCREW (S&R TYPE)
4-DRUM
5-MICRO SWITCH
6-WRITING GALVANOMETER
7-DRIVE & HEATING SWITCHES
HEATING CONTROL
8-SPEED CHANGING GEARS
9-DC AMPLIFIER - SANBORN 67-300

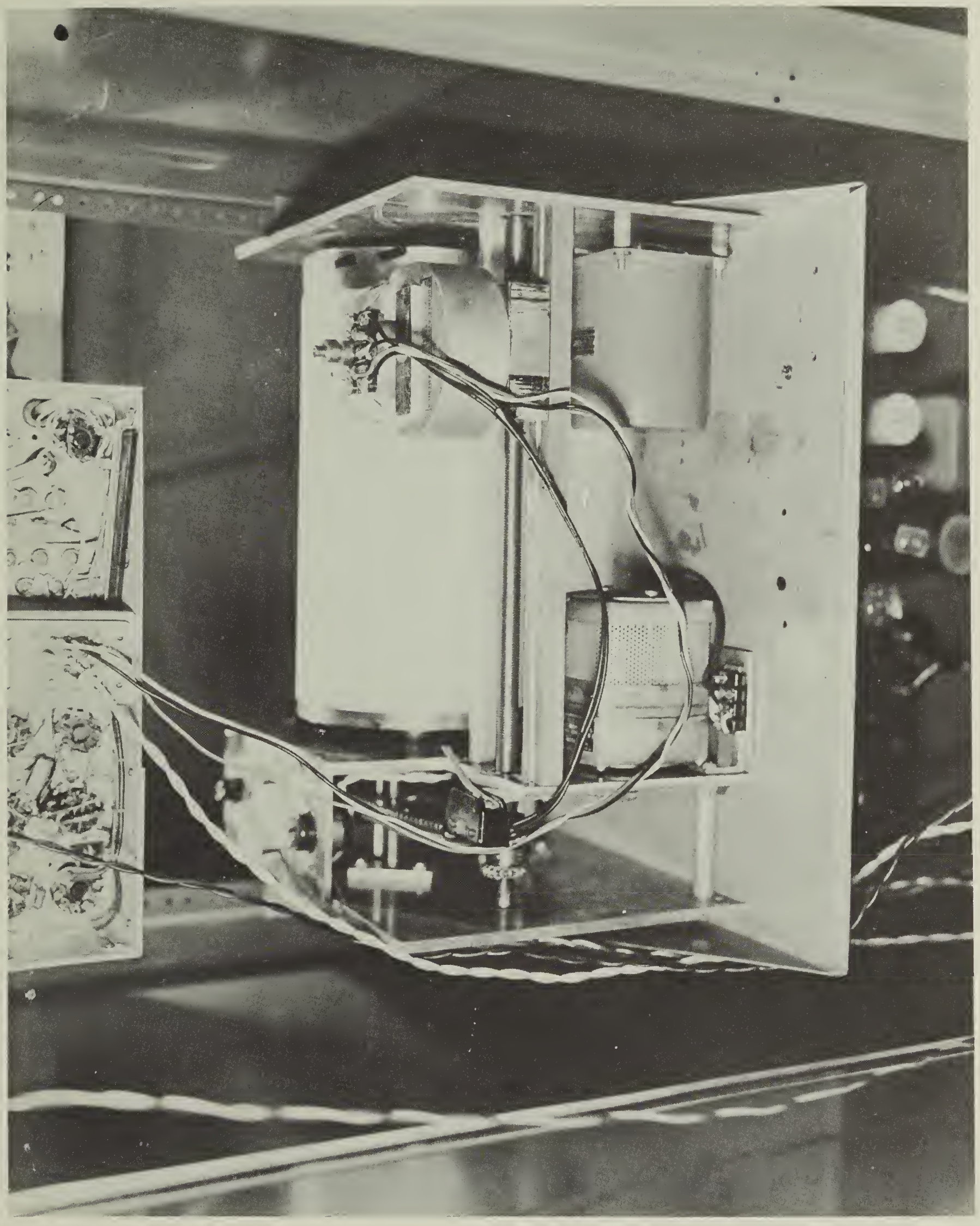


Figure 2. Rear view small recorder.

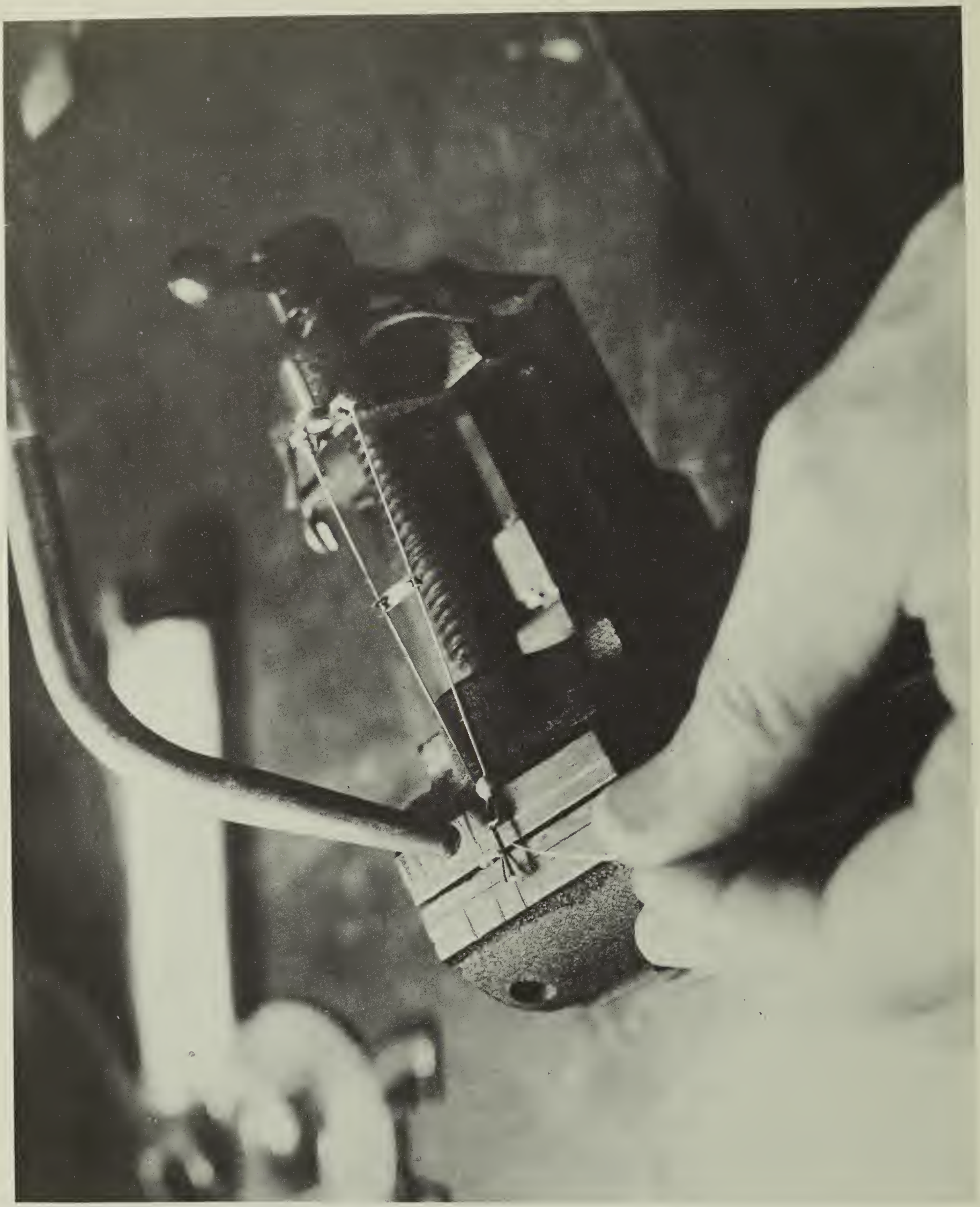


Figure 3. Silver soldering sapphire phonographic stylus to writing arm.

Figure 4. Heating element of writing arm with sapphire stylus attached, magnified 3 x.

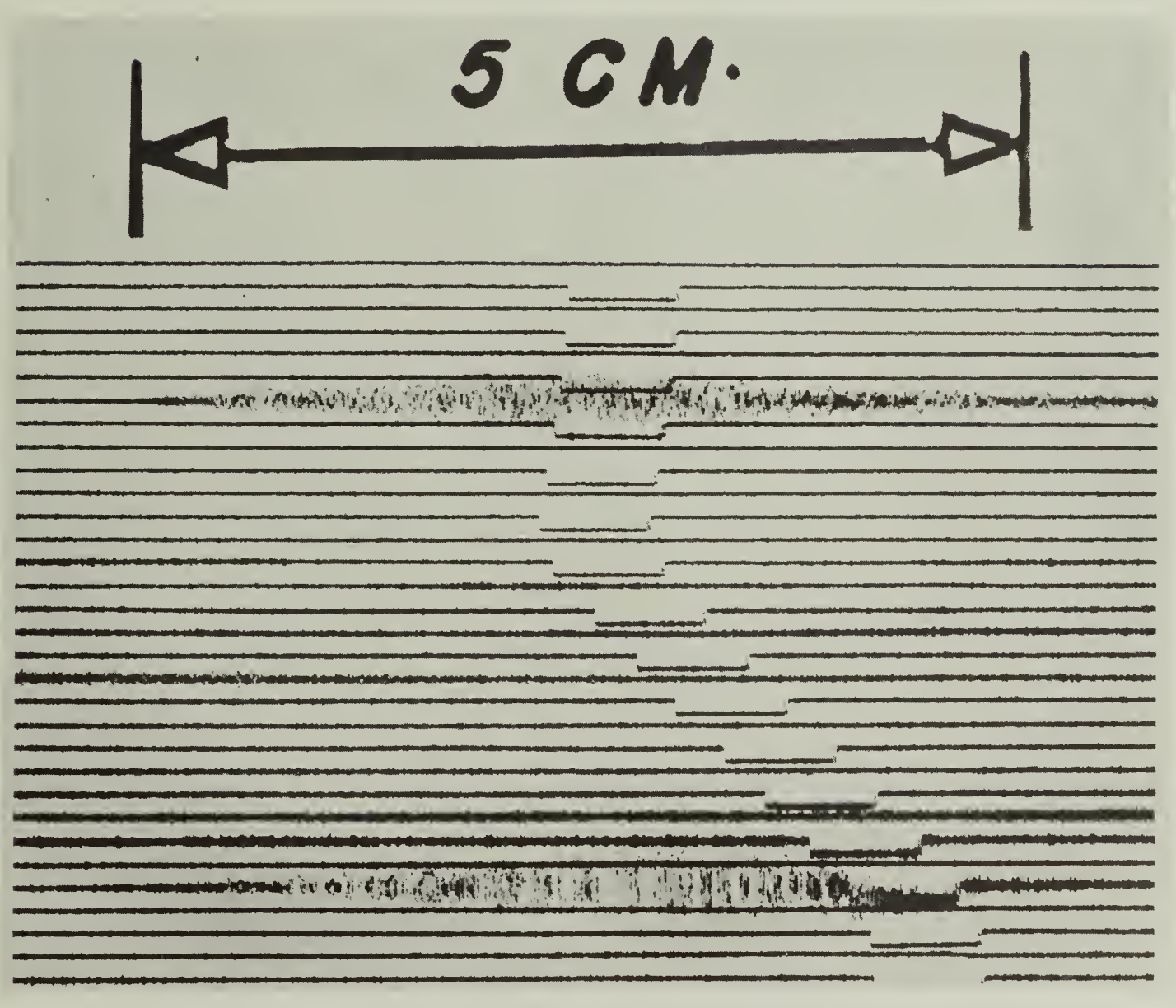
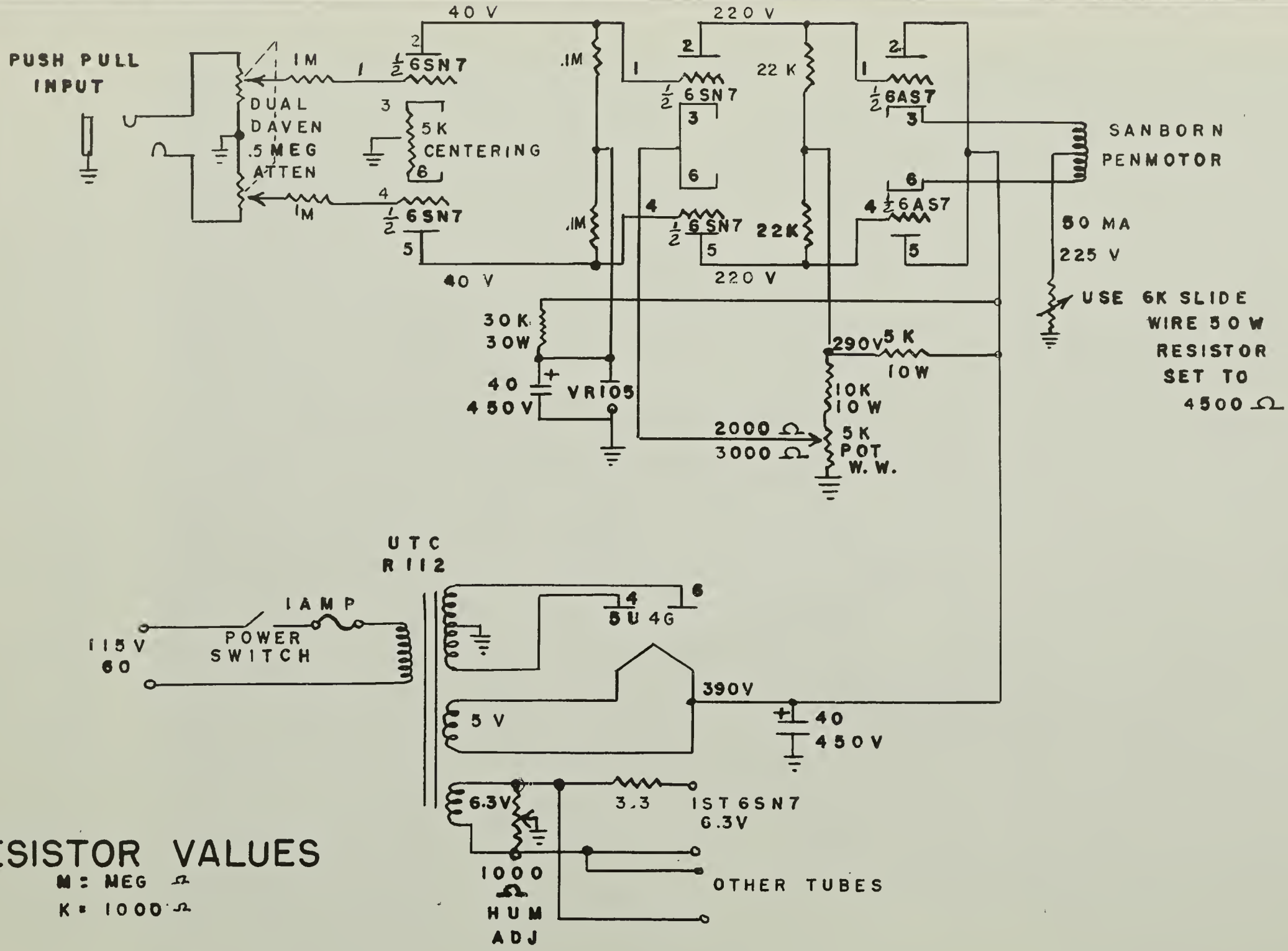


Figure 5. Part of sample record magnified 1.5 x: the instrument being recorded is a SOFAR hydrophone in 400 fathoms of water east of Bermuda. The two large signals are T phases of submarine earthquakes. Five centimeters represents 25 seconds of time on this record. The offset marks are minute time ticks. Time runs from left to right.



RESISTOR VALUES

M = MEG Ω

K = 1000 Ω

FIGURE 6

DC LINEAR DRIVE AMPLIFIER FOR SANBORN WRITING GALVANOMETER

Frank Watlington